

# Starter Questions (non calc)

**Q1**

Simplify the following.  
Give your answer as a number not involving logs.

**Q2**

Simplify the following.  
Give your answer as a number not involving logs.

**Q3**

Simplify the following.  
Give your final answer as a fraction.

**Q4**

Simplify the following.  
Give your final answer as a fraction.

**Q5**

Solve  
Give your answer to 3sf

**CALC OK ONLY FOR  
THIS ONE**

**Q6**

Solve

F3

Know and use the definition of  $\log_a x$  as the inverse of  $a^x$ , where  $a$  is positive and  $x \geq 0$ .

Know and use the function  $\ln x$  and its graph.

Know and use  $\ln x$  as the inverse function of  $e^x$

Students should:

- understand and be able to use the equivalences:  $y = a^x \Leftrightarrow \log_a y = x$  and  $y = e^x \Leftrightarrow \ln y = x$
- know that the graph of  $y = \ln x$  is a reflection in the line  $y = x$  of the graph of  $y = e^x$
- be able to perform simple single transformations (as defined in section B9) of the functions  $y = e^x$  and  $y = \ln x$
- be able to manipulate logs and exponentials within the solution to a problem.

F5

Solve equations of the form  $a^x = b$ .

Students should be able to solve equations of the form  $a^x = b$ , including  $e^x = b$

Notes

- Equations of this form may require exact answers.
- If exact answers are not required such equations may be solved using a calculator, unless instructions are given to the contrary.

[Numberphile Video about e](#)

## 5.2 Exponential Functions

$$y = a^x \longleftrightarrow \log_a y = x$$

so applies for the special case when the base is e:

$$y = e^x \longleftrightarrow \log_e y = x$$

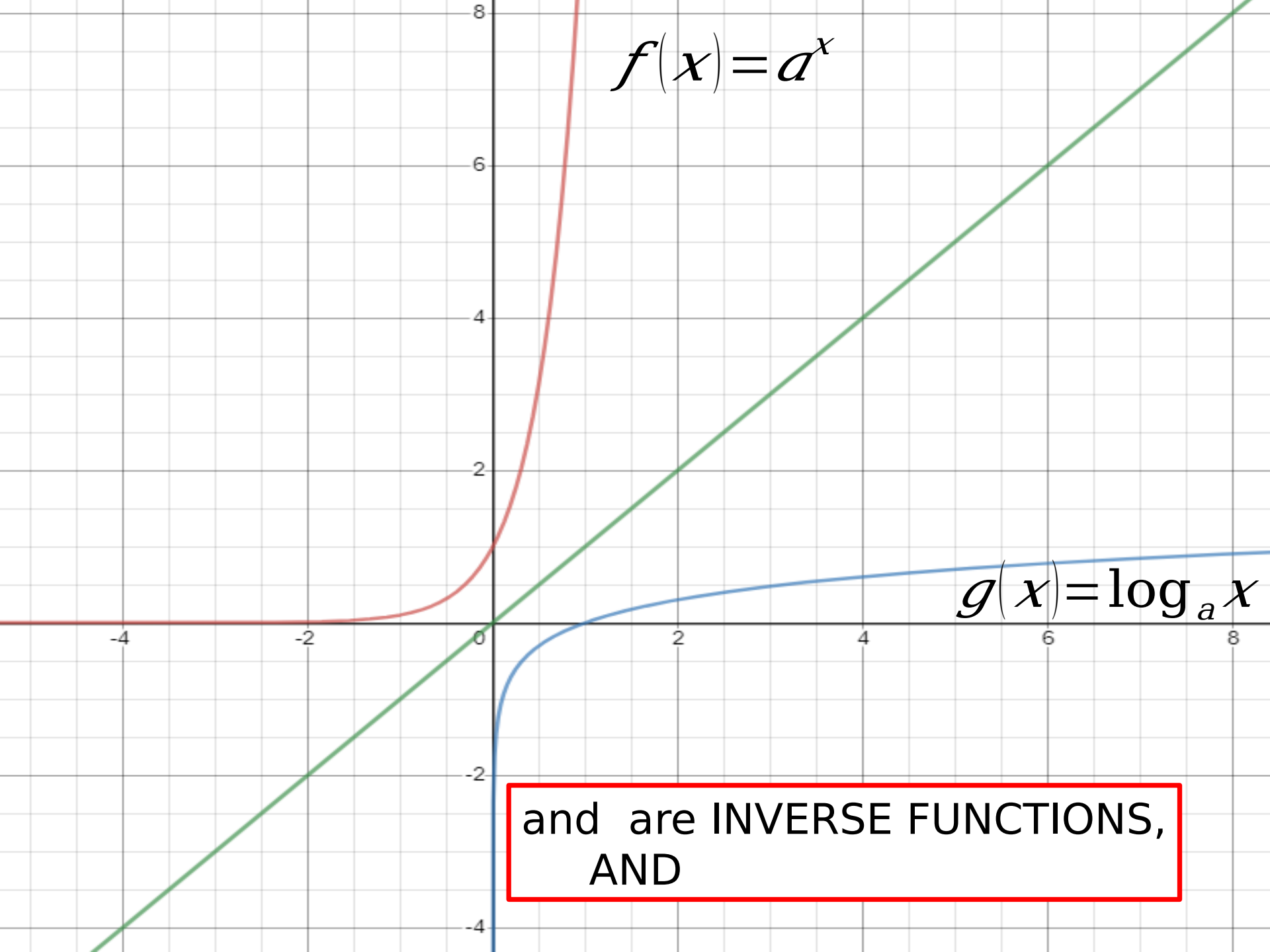
$$y = e^x \longleftrightarrow \ln y = x$$

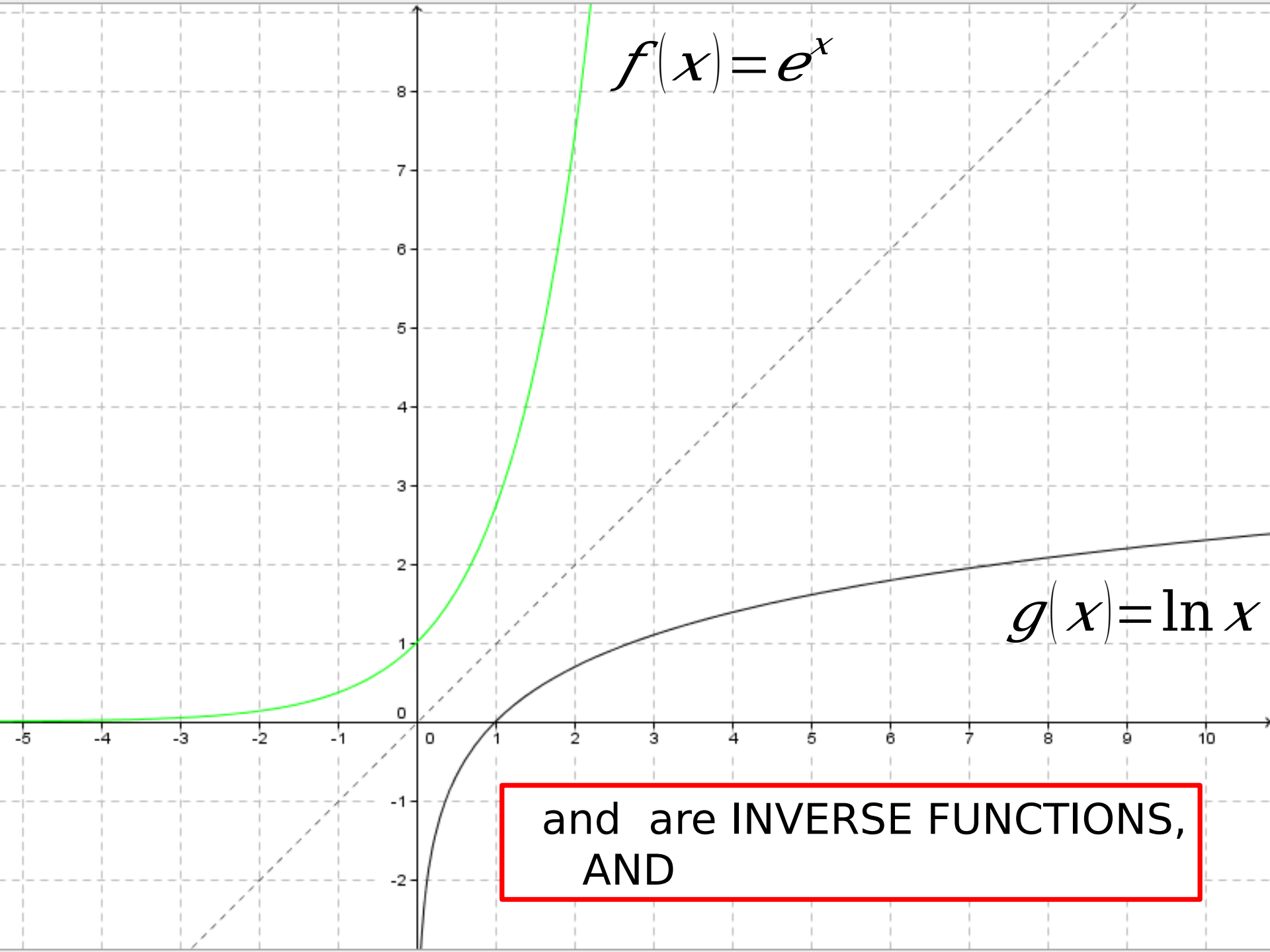
= 2.71828 to 5dp

$$f(x) = a^x$$

$$g(x) = \log_a x$$

and are INVERSE FUNCTIONS,  
AND





## 5.2 Exponential Functions

Graphs of  $e^x$ ,  $\log(x)$  and  $\ln(x)$  can be transformed in the same way as other graphs.

e.g. Describe the transformation that maps  $y=e^x$  onto

a)  $y = e^x + 1$

b)  $y = e^{x+1}$

c)  $y = 2e^x$

d)  $y = -e^x$

# 5.2 Exponential Functions

The curve with equation  $y = \ln x$  is transformed by a stretch parallel to the  $x$ -axis with scale factor 2

Find the equation of the transformed curve.

Circle your answer.

$$y = \frac{1}{2} \ln x$$

$$y = 2 \ln x$$

$$y = \ln \frac{x}{2}$$

$$y = \ln 2x$$

The curve  $y = \log_4 x$  is transformed by a stretch, scale factor 2, parallel to the  $y$ -axis.

State the equation of the curve after it has been transformed.

Circle your answer.

$$y = \frac{1}{2} \log_4 x$$

$$y = 2 \log_4 x$$

$$y = \log_4 2x$$

$$y = \log_8 x$$



# 5.2 Exponential Functions

## The Multiplication Law

$$\log_a m + \log_a n = \log_a mn$$

$$\ln m + \ln n = \ln mn$$

## The Division Law

$$\log_a m - \log_a n = \log_a \frac{m}{n}$$

$$\ln m - \ln n = \ln \frac{m}{n}$$

## The Power Law

$$\log_a x^n = n \log_a x$$

$$\ln x^n = n \ln x$$

...using the power law...

$$\log_a \left( \frac{1}{y} \right) = -\log_a y$$

$$\ln \frac{1}{y} = -\ln y$$

# 5.2 Exponential Functions

$$\log_a a = 1$$

$$\log_e e = 1$$

$$\ln e = 1$$

$$\log_a 1 = 0$$

$$\log_e 1 = 0$$

$$\ln 1 = 0$$

$$\log_a \frac{1}{a} = -1$$

$$\log_e \frac{1}{e} = \log_e e^{-1}$$

$$\ln \frac{1}{e} = -1$$

# 5.2 Exponential Functions

Simplify:

a)

b)

c)

# 5.2 Exponential Functions

Solve:

a)

b)

c)

# 5.2 Exponential Functions

Solve:

a)

b)

c)

**Exercise 14G  
&  
Challenge Qs**